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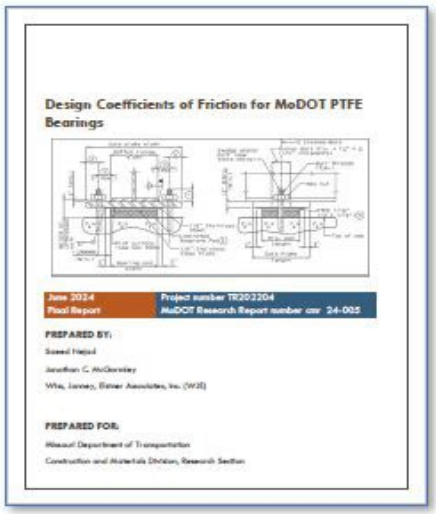
Research Summary

Design Coefficients of Friction for MoDOT PTFE Bearings



Wiss, Janney, Elstner Associates, Inc. conducted an experimental program to investigate and validate essential Polytetrafluoroethylene (PTFE) bearing performance criteria, allowing for potential adjustments in bearing design procedures to improve the efficiency in designing substructure elements. This experimental program was designed and implemented, examining seven parameters for study: PTFE material types, surface types, size, contact pressure, temperature, sliding speed, and surface contamination. Seven standard Type N PTFE bearing specimens used by the Missouri Department of Transportation (MoDOT) were tested, including four PTFE types: unfilled flat, filled flat, unfilled dimpled, and filled dimpled. A testing matrix of thirteen tests, each comprising sixteen to over a hundred cycles, was executed using a testing apparatus that facilitated the simultaneous application of vertical and horizontal loads to a test pad.

The report's analysis indicated that unfilled dimpled lubricated PTFE and filled flat PTFE showed the lowest and highest coefficients of friction, respectively. The coefficients for unfilled flat and filled dimpled PTFE fell in between. It was determined that coefficients of friction increased with increased sliding speeds and surface contamination but decreased with increased contact pressure. No consistent changes were noted with variations in specimen size or at low temperature.

Surface contamination significantly raised friction coefficients—light dust levels caused a tenfold increase in friction, while heavier contamination halted sliding. Both flat and dimpled PTFE specimens displayed increased friction with higher loading rates. Once elevated, friction values did not decrease even when loading rates decreased, suggesting irreversible changes to the PTFE surfaces due to thermal and mechanical stresses encountered during testing.

A review of twenty-five states showed no specific mandate by departments of transportation requiring protection of PTFE elastomeric bearing pads from surface contamination. Although past studies recommended various shrouding methods, these were not verified through long-term studies. Despite preventive measures, real-world conditions show that dust accumulation occurs emphasizing the need for regular maintenance and protective strategies, potentially verified by laboratory or field tests, to maintain the longevity and functionality of PTFE bearings.

"Updated design coefficients of friction for PTFE bearings could be used to efficiently design substructure elements."

The experimental results for the coefficient of friction were compared with those from NCHRP Project 10-20 (Report 432), which were adopted

as the PTFE bearing design coefficients in the AASHTO LRFD Bridge Design Specifications (BDS). A comparison of test results with the NCHRP findings and referenced to AASHTO LRFD BDS and MoDOT design values, led to proposed updated design coefficients of friction for four primary PTFE bearing types: flat (both unfilled and filled) and dimpled lubricated (both unfilled and filled).

Key parameters for future studies were outlined, including extended testing and microscopic examination of PTFE surfaces to better understand the dependencies of friction coefficients on load cycles, sliding speeds, and surface contamination. Additionally, unexplored factors such as eccentric loading and surface roughness were identified, necessitating further experimental investigation.

Figure 1: Sketch and photos from deployed instrumentation tree.

Project Information

PROJECT NAME: TR202204—Design Coefficients of Friction for MoDOT PTFE Bearings

PROJECT START/END DATE: November 2022-May 2024

PROJECT COST: $200,000

LEAD CONTRACTOR: Wiss, Janney, Elstner Associates Inc.

PRINCIPAL INVESTIGATOR: Jonathan C. McGormley, Saeed Nejad

REPORT NAME: Design Coefficients of Friction for MoDOT PTFE Bearings

REPORT NUMBER: cmr 24-005

REPORT DATE: May 2024

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